SPECIES-HABITAT RELATIONSHIPS IN AN OREGON COLD DESERT LIZARD COMMUNITY

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Abstract.— The abundance and diversity of lizards in nine habitat types from Oregon were studied from May through October 1980. Eight species were from eight habitat types. The most common species were *Sceloporous occidentalis*, *Uta stansburiana*, *Sceloporous graciosus*, and *Cnemidophorus tigris*. *Phrynosoma douglassi* was uncommon and *Eumeces skiltonianus* was not observed. Temporary streams in nonbasaltic areas were the most productive habitat in terms of lizard abundance but sagebrush areas were the most productive habitat in terms of species diversity. No lizards were recorded from grassland conversion areas. The conflict between a land management policy that emphasizes both vegetation conversion and conservation of present wildlife stocks is discussed.

The herpetofauna of Malheur County, located in the extreme southeastern corner of Oregon, has been largely neglected in spite of the biological interest in this transition zone between the Great Basin and the cold desert areas of northern Oregon, Washington, and Idaho (Storm and Pimentel 1949, Ferguson et al. 1958, St. John 1980). The purpose of this study was to survey the herpetofauna and relate abundance and diversity to habitat type. Herein I report my findings on the structure of the lizard community. The abundance and diversity of amphibians and snakes is reported elsewhere (Werschkul 1980).

Study Area

The climate of southeastern Oregon is characterized by variation with short, hot summers, mean July temperature of 25 C, and long, cold winters, mean temperature between November and March of 4.6 C (Loy et al. 1976). Rainfall is highest in May, 40 mm, and lowest in August, 6 mm. A complex geologic area, early Miocene extrusions of basalt and rhyolite form the foundations for present formations (Kittleman et al. 1967, Kittleman 1973). Bisected by erosion, these volcanic platforms have formed elongate ridges and basins with deposition of alluvial materials along river channels. Plant communities from this high desert ecosystem, the juniper-sagebrush woodland extension of the Great Basin pinyon-juniper woodland (Detling 1968), have been classified by Franklin and Dyrness (1973), and, although big sagebrush (*Artemisia tridentata*)/bluebunch wheatgrass (*Agropyron spiratum*) is recognized as the climatic climax (Eckert 1957, Tueller 1962), native grasses have largely disappeared because of livestock grazing (Tueller 1962). Regardless, the composition of the plant community responds to local conditions and black sagebrush (*Artemisia arbuscula*) is found on shallow soils, shadscale (*Atriplex confertifolia*) and hopsage (*Grayia spinosa*) are common on xeric sites, and greasewood (*Sacrobatus vermiculatus*) dominates on sandy and alkaline sites.

Methods

The areas censused were bordered to the east by the Oregon-Idaho state line (117°05′W), to the west by the Alvord Desert (118°30′W), to the south by the Oregon-Nevada state line (42°00′N), and to the north by the Malheur River (44°00′N) from May through October 1980 (Fig. 1). Each census site was classified into one of nine habitat types depending on the composition of the plant community and the geologic and soil conditions. These habitat types were sagebrush, alkaline flats, grasslands, rocky areas of basaltic or nonbasaltic origin, temporary streams in basaltic or nonbasaltic areas, permanent streams, and sand dunes.

Sagebrush.— A composite category for sagebrush areas including higher elevation sites of sagebrush in association with bitter-

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brush (*Purshia tridentata*), juniper (*Juniperus occidentalis*), and mountain mahogany (*Cercocarpus ledifolius*); xeric sites with saltbrush (*Atriplex* sp.); and rocky areas with black sagebrush, as well as the more common plateau and basin regions with nearly pure stands of big sagebrush.

ALKALINE FLATS.— The shrub community from these ancient lakebeds, or playas, include shadscale, hopsage, and greasewood, although on extremely alkaline areas the vegetation was absent except on small (ca 10 m²) hummocks.

GRASSLANDS.— Native grasses have largely disappeared because of livestock grazing. Range restoration projects, under the administration of the Vale District of the Bureau of Land Management, include seeding of crested wheatgrass (*Agropyron cristatum*) (Heady and Bartolome 1977), and it is these areas I censused during this study.

ROCKY AREAS OF BASALTIC ORIGIN.— Those rocky areas that included exposed bluffs, talus slopes of basaltic rubble, and the more recent basaltic extrusions of the smooth pahoehoe type.

ROCKY AREAS OF NONBASALTIC ORIGIN.— A composite category that included areas as diverse as arkose sandstone and hard pyroclastic flows. Shrub cover was always sparse, less than one shrub stem per 25 m².

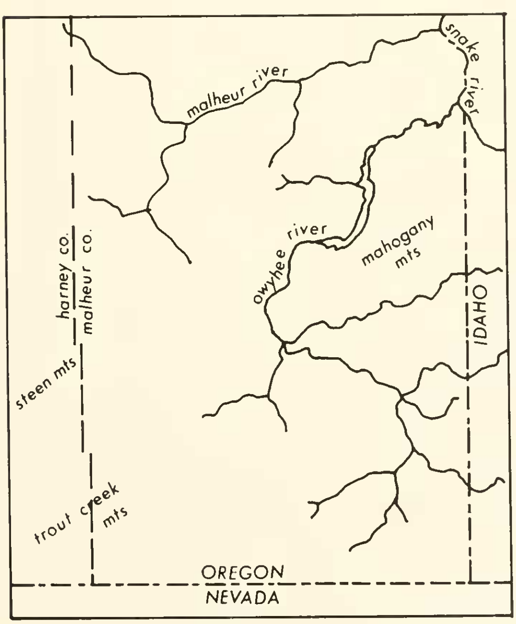

Fig. 1. Location of survey, Malheur County, Oregon.

SAND DUNES.— Sandy areas devoid of vegetation except for border cover, usually greasewood or big sagebrush.

TEMPORARY STREAMS IN BASALTIC AREAS.— Streams on ridges and steep slopes usually eroded to basalt; sandy areas might be present, but they were not extensive. The most common woody plants were willows (*Salix* spp.) and chokecherry (*Prunus* sp.).

TEMPORARY STREAMS IN NONBASALTIC AREAS.— Streams on relatively flat areas usually did not erode to basalt, although basaltic boulders were sometimes present. Woody plants were for the most part absent and the plant community was similar to that found in sandy, slightly alkaline areas and included greasewood, rabbitbrush (*Chrysothamnus* spp.), and Indian ricegrass (*Oryzopsis hymenoides*).

PERMANENT STREAMS.— Those areas adjacent to permanent flowing water. Usually, a well-developed riparian community of willows, cottonwood (*Populus trichocarpa*), and hawthorn (*Crataegus* spp.) was present.

Lizards were censused by slowly walking (ca 0.5 m sec^{-1}) through areas noting those species present. Each census period lasted 20 minutes, and animal abundance was calculated as the number of animals seen per census period. In general, animals were not pursued or captured unless identification was uncertain. An area might be censused repeatedly, but no particular site was censused more than once. For example, Jordan Craters, a large expanse of recent basaltic extrusions (Kindschy and Maser 1978), was censused for 17 census periods, although no particular site was visited more than once. Most censuses were made during the morning, 0630–1030, and the afternoon, 1500–1900, although some censusing occurred at other times.

Malheur County, the study area, is large, approximately 2.6 million ha. Consequently, areas censused were representative of the habitats found there. Some areas were chosen because of reports of one species or another. To minimize error in determining species-habitat relationships, I censused each habitat type often enough, a total of 358 census periods or 4160 minutes, to reduce the impacts of season, time of day, and weather on animal activity (see Mayhew 1968, Parker and Pianka 1976). It is recognized that the *Phrynosoma* are probably underestimated and *Eumeces* may have been missed due to the survey technique used here.

Results and Discussion

Nine species comprise the lizard fauna of southeastern Oregon (Stebbins 1954, St. John 1980), eight of which were recorded during this study (Table 1). The most commonly observed species were *Sceloporous occidentalis*, *Uta stansburiana*, *Sceloporous graciosus*, and *Cnemidophorus tigris*. *Phyrnosoma douglassi* were uncommon, only two sightings, and *Eumeces skiltonianus* were not observed (but see St. John 1980). A total of 192 lizards or 0.5 animals per census period was recorded.

Habitat importance values were calculated in two ways: (1) as the percent of census sites per habitat type with at least one animal sighted, and (2) the average number of animals per successful census site (those sites with at least one animal sighting). As might be expected, these methods of estimating species-habitat values are positively correlated (Spearman Rank Correlation = 0.48; $p < 0.01$; $n = 29$), although some noteworthy exceptions exist. For example, for temporary streams in nonbasaltic areas *S. occidentalis* were found in 9.1 percent of the census sites, a relatively low value, but averaged 2.7 animals per successful census site. This may have resulted from the fact that, when large boulders (used for sunbathing) were present, *S. occidentalis* were more commonly observed than when large boulders were absent. Likewise, *S. graciosus* were relatively uncommon in sagebrush areas, 4.4 percent of the census sites, although relatively high numbers were found when encountered, 2.1 animals per successful census site. In this case, *S. graciosus* were uncommonly observed except where small mammal burrows were present. These lizards apparently use these burrows to aid in thermoregulation and to avoid predators. Conversely, although *Gambelia wislizeni* were commonly observed from temporary streams in nonbasaltic areas, 18.1 percent of census sites, numbers were always low, 1.5 animals per successful census site. *Gambelia wislizeni*, however, were not

TABLE 1. Occurrence of lizards from nine habitat types from Malheur County, Oregon.

			Habitat								
Species	n[a]	N[b]	Sagebrush	Alkaline flats	Grasslands	Rocky basalt	Rocky nonbasalt	Sand dunes	Temporary streams in basalt areas	Temporary streams in nonbasalt areas	Permanent streams
Crotaphytus bicinctores	10	20	1.3[c] 2.00[d]	—	—	7.1 1.00	—	—	—	15.1 2.60	—
Gambelia wislizeni	18	25	5.0 1.28	11.1 1.50	—	—	—	12.5 2.00	—	18.1 1.50	—
Sceloporus occidentalis	20	40	2.5 1.23	—	—	19.5 2.33	7.1 1.00	—	7.7 1.00	9.1 2.67	6.4 2.00
Sceloporus graciosus	16	32	4.4 2.10	33.3 2.30	—	6.8 1.00	—	—	—	—	—
Uta stansburiana	16	38	1.9 1.70	—	—	—	—	—	—	33.3 2.70	6.4 1.50
Phrynosoma douglassi	2	2	1.3 1.00	—	—	—	—	—	—	—	—
Phrynosoma platyrhinos	8	10	2.5 1.00	11.1 1.50	—	—	—	12.5 1.50	—	—	—
Cnemidophorus tigris	19	30	5.0 1.70	5.5 1.00	—	2.2 1.00	—	25.0 2.00	—	12.1 1.30	3.2 1.00

[a]Number of census periods with at least one animal sighting.
[b]Total number of animals sighted.
[c]Percent of census sites with at least one animal sighting.
[d]Average number of animals per successful census period.

observed in high numbers in any habitat (Table 1) and it is suspected that some spacing mechanism may be at work. Overall, when microhabitat characteristics cause clumping, such as the presence of boulders for *S. occidentalis* or small mammal burrows for *S. graciosus*, then the number of animals per successful census site tend to overestimate habitat importance.

Sagebrush habitat, in terms of species observed, was the most productive census area, with all eight species observed (Table 1). Grasslands, with no observations, was the least productive. Shrub cover is important in determining lizard distribution and abundance patterns by providing shaded areas needed for thermoregulation and as hiding sites from predators (Germano and Hungerford 1981). Shrub cover removal, by reducing the vertical and horizontal habitat stratification and shading and hiding areas, results in poor habitat for lizards. In terms of abundance, the habitat associated with temporary streams in nonbasaltic areas was the most productive and grasslands the least productive (Table 2). Each species had a preferred habitat (Table 1), and that associated with temporary streams in nonbasaltic areas was preferred by more species, three, than any other habitat type. Although sagebrush areas had the highest number of species observed, only *P. douglassi* preferred this habitat type (Table 1) and the average number of lizards seen per census period was comparatively low (Table 2).

The complete lack of observations of lizards in grasslands was unexpected. Although studies of lizard-habitat relationships in Arizona have shown low use of grasslands areas by most species, some species (e.g., Sonora spotted whiptail, *Cnemidophorus sonorae*) were more common in grasslands than elsewhere, and only a minority of species (4 of 9) went unrecorded in grasslands (Germano and Hungerford 1981). Two possible factors contributing to the lack of lizard sightings in the grasslands from this study were: (1) I ex cluded, as much as possible, any edge effects during censusing by picking grassland areas away from other habitat types and areas lacking sagebrush, boulders, or any other features causing habitat stratification, and (2), during the study year, rainfall was high, causing dense and tall stands of grasses to develop. This increased the technical difficulties associated with the walking transect survey and may have caused local lizard movements to habitats with open areas needed for foraging. It seems unlikely that all species of lizards avoided grasslands at all times, and some species may benefit from increases in the acreage of grasslands (Germano and Hungerford 1981). Census of areas with habitat discontinuities may have shown more use of grasslands by lizards than indicated here.

Still, to a large extent, lizards failed to use grasslands in this study area and a question arises relative to the economic necessity for expanding grasslands and the desire to conserve wildlife stocks. Grasslands, important for livestock production, were avoided by lizards in this study, and other plant communities, important to lizards, are unproductive for livestock. My findings suggest that, when

TABLE 2. The abundance and diversity of lizards for nine habitat types from Malheur County, Oregon. Diversity (H) is measured as the Shannon-Weaver index ($H = \Sigma -p_i \ln p_i$).

Habitat	Number of census periods	Number of species	H	Average number of lizards per census period
Temporary streams in nonbasaltic areas	33	5	1.41	1.97
Alkaline flats	18	4	0.97	1.17
Sand dunes	16	3	1.01	0.94
Rocky basaltic areas	46	4	0.83	0.61
Sagebrush	156	8	1.87	0.36
Permanent streams	31	3	0.94	0.26
Temporary streams in basaltic areas	13	1	—	0.08
Rocky nonbasaltic areas	14	1	—	0.07
Grasslands	18	0	—	0.00

multiple use management is desired, conversion areas need to maintain some characteristics of the native vegetation. For example, areas adjacent to temporary streams, frequently not suitable for crested wheatgrass, if conserved, would reduce the costs to the lizard community resulting from vegetation control programs. Importantly, dispersal corridors for the lizards, as well as valuable habitat for other wildlife, would be conserved. Finally, sagebrush areas are especially important to lizards, because all species were found to use this habitat. Management programs should follow the advice of Germano and Hungerford (1981) and clear variously shaped areas rather than attempt total removal of all nongrass vegetation.

Acknowledgments

Bob Kindschy provided information on lizard locations in southeastern Oregon. This study was supported by the Bureau of Land Management (OR 910-CTO-14).

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